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(71) Applicant: DIALNET, INC. [US/US]; 148 Allston Street, Cambridge, MA 02139 (US).

(72) Inventors: LEE, Don, Joon; 148 Allston Street #2, Cambridge, MA 02139 (US). YAN, Charles; 29 Knollwood Court, Burlington, MA 01803 (US).

(74) Agent: GORDON, Peter, J.; Wolf, Greenfield & Sacks, P.C., 600 Atlantic Avenue, Boston, MA 02210 (US).

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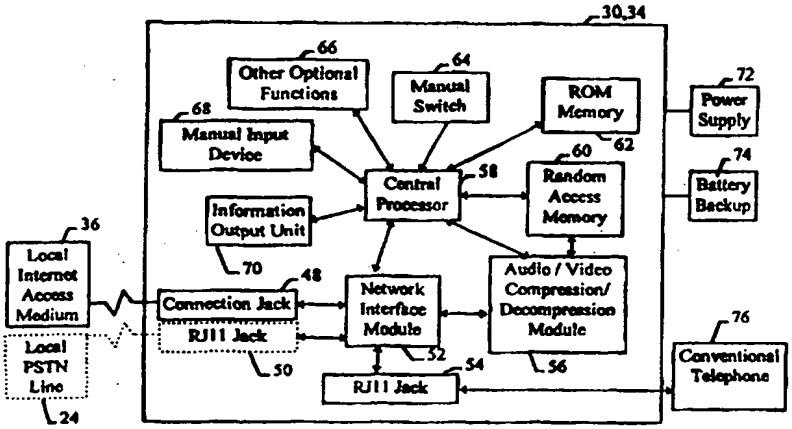

(57) Abstract

A dedicated appliance for packet-switched voice communication is provided with a mechanism to ensure that both the caller and a recipient of voice communication having a similar appliance have a connection to the packet-switched network. Such an appliance eliminates the need for complex and expensive multimedia computer systems and Internet telephony software which requires a pre-existing network connection for both parties prior to initiating communication. In one embodiment of the invention, a caller's appliance may cause a recipient's appliance to connect to the packet-switched network through the access medium of the recipient. Another mechanism which enables switching between circuit-switched and packet-switched voice communication allows for both kinds of communication to be used by the same appliance. Once connected to the network, the caller and recipient may establish a connection therebetween over the packet-switched network to permit communication. Network service providers (NSP) which provide access to the packet-switched networks for users do not need to dedicate connection ports to voice communication and therefore can allow use of any connection port for any purpose with the existing infrastructure.

DEDICATED SYSTEM AND PROCESS FOR DISTRIBUTED COMMUNICATION ON A PACKET-SWITCHED NETWORK

Field of the Invention

The present invention is related to communication over packet-switched networks. The present invention is more particularly related to voice communication using such networks.

Background of the Invention

Voice communication typically uses a circuit-switched network. Such a network is maintained by regional and long distance telecommunication carriers, and typically provides a dedicated channel for each connection established between subscribers for voice communication. A circuit-switched network is expensive to operate, which in turn causes users to incur significant charges, particularly for long distance calls. Additionally, each connection requires a direct path between two locations, typically determined using a complex algorithm. Additionally, each connection is recorded for billing purposes. The overhead incurred for billing is a substantial portion of the cost in maintaining the network.

Recently there has been an increased interest in the use of packet-switched networks for voice communication. In particular, a global network of computers using a packet-switched network, commonly known as the Internet, has been the platform for some computer software that allows for voice communication between two or more individuals connected to the Internet.

Because packet-switched networks are less expensive to use and more versatile than circuit-switched networks, there is an increasing interest in developing their use for voice and video communication. However, there are some drawbacks to packet-switched networks. First, packet-switched networks are used primarily for general data communication. At present, it generally does not guarantee reliable real-time performance, particularly for voice communication. The lack of reliable real-time communication results in degradation of the quality of voice data transmitted over the network. These problems will eventually be overcome as technology and communication standards develop. A second problem is that both users who wish to communicate by voice over a packet-switched network have to have operative connections to the network. It is not possible at the present time to initiate voice communication over the packet-switched network without each party establishing their own connection to the network prior to communication being initiated by one of the parties. This requirement is in stark contrast to the circuit-switched networks where the recipient of a conventional telephone

recipient's appliance to connect to the packet-switched network through the access medium of the recipient. Another mechanism which enables switching between circuit-switched and packet-switched voice communication allows for both kinds of communication to be used by the same appliance.

Once connected to the network, the caller and recipient may establish a connection therebetween over the packet-switched network to permit communication. Network service providers (NSP) which provides access to the packet-switched networks for users do not need to dedicate connection ports to voice communication and therefore can allow use of any connection port for any purpose with the existing infrastructure.

Accordingly, one aspect of the invention is a communication system using a packet-switched network. The communication system includes a first network access system for providing access to the packet-switched network. A second network access system also provides access to the packet-switched network. A first appliance has a mechanism for connecting to the first network access system through a first access medium, and sends and receives packets through this connection to the packet-switched network. A second user appliance has similar capabilities. In addition, the second user appliance has mechanisms for causing the first appliance to connect to the packet-switched network through the first network access system. The first and second appliances then can send and receive packets to and from one another through the packet-switched network.

Another aspect of the invention is an appliance for communication using a packet-switched network. The appliance connects to a first access medium, and in turn connects to a first network access system connected to the packet-switched network using the access medium. The appliance includes a mechanism for causing another appliance to be connected, through a second access medium, to a second network access system connected to the packet-switched network. After the connection of the other appliance is made, the two appliances may send and receive packets through the packet-switched network to each other.

In one embodiment of the invention, the first appliance is caused to connect to the packet-switched network by first connecting with the first appliance using a public switched telephone network (PSTN) encompassing a local exchange carriers (LEC) and an inter-exchange carrier (IXC) then instructing the first appliance to connect to the first network access system using its access medium. In another embodiment of the invention, the first appliance is caused to connect to the packet-switched network by the second appliance dialing the first appliance using PSTN

Fig. 2a is a more detailed block diagram of one embodiment of the telephone appliance shown in Fig. 1;

Fig. 2b is a more detailed block diagram of another embodiment of the telephone appliance shown in Fig. 1;

Fig. 3 is a more detailed block diagram of the central database (CBD) shown in Fig. 1;

Fig. 4 is a more detailed diagram of the dedicated communication facility (DCF) as shown in Fig. 1;

Fig. 5a is a flow chart of one embodiment of a process for making an Internet telephone call using the voice communication system of the present invention;

Fig. 5b is a flow chart of another embodiment of a process for making an Internet telephone call using the LEC caller identification service with the voice communication system of the present invention;

Fig. 6a is a flow chart of an embodiment of a process for using the voice communication system of the present invention using dial-out possibilities with existing network service providers;

Fig. 6b is a flow chart of another embodiment of a process for using the voice communication system of the with dedicated dial-out service providers;

Fig.7 is a flow chart of an embodiment of a process for using the voice communication system of the present system with a continuous link to a packet-switched network;

Fig. 8 is a flow chart describing the process to check if a recipient's telephone number has an appliance.

Fig. 9 is a flow chart describing how the telephone appliance contacts a local Internet service provider to establish a PPP/SLIP link;

Fig. 10 is a flow chart describing how the central database is updated;

Fig. 11 is a flow chart describing how the recipient's dedicated communication facility makes an outgoing telephone call;

Fig. 12 is a flow chart describing query processing in the central database;

Fig. 13 illustrates an example information packet for the central database; and

Fig. 14 is a diagram illustrating an example data portion of a packet containing one or more type length and value entities.

invention, the users of appliances 30 and 34 typically incur charges for obtaining access through a local network access medium 36 and 38 such as the local telephone company and/or a network service provider 40 and 42.

The appliance 30, 34 will now be described in connection with Figs. 2a and 2b. One form of packaging of the appliance may be a separate box that connects between a connector to the network access medium and a conventional telephone 76 for which the circuitry is shown in Fig 2a. This form of packaging may be integrated with other appliances such as cable television converter boxes and high-definition digital televisions to provide integrated telephony services using cable Internet access or video telephony using a small window image on a high-definition television (HDTV) set.

Another form of packaging of the appliance may be like a conventional telephone for which the circuitry shown in Fig. 2b is same as in Fig. 2a except for numeric keypad 66', handset with a transmitter 78 (e.g., microphone) and receiver 80 (e.g., speaker), and an integrated conventional telephone interface electronics 77. Yet another form of packaging could be a single household model for allowing all phones connected to the main household phone line to use Internet telephony.

The appliance has an Internet access jack 48 to permit connection to a network service provider. The Internet access jack can also accommodate other network connections depending on the network access medium such as coaxial cable connector for cable access or a conventional phone jack such as an RJ-11 connector if connecting to an LEC via a POTS modem. If the connection jack 48 is not a conventional phone jack, a conventional phone jack 50 such as an RJ11 jack can be made available for connection to the PSTN line for making conventional calls. Such means of network and phone connection allows the appliance to function just like a regular phone for local phone calls, but for long-distance phone calls, which may be detected by examining the telephone number of the appliance users from the central database 46, it may connect automatically into the network, if there is an appliance user corresponding to the telephone number, or into an IXC if there is no appliance user corresponding to the telephone number.

The appliance does not require both parties to be already linked to the network to initiate communication. At least five modes of operation may be provided for establishing a connection with the recipient. One mode uses a conventional long-distance telephone call to cause the recipient's appliance 34 to initiate a connection with its own network service provider, as

functions. The appliance uses the random access memory 60 and 60' to temporarily store operation code and data during operation. The network interface module 52 and 52' may be a stand-alone chip, chipsets, and/or other means that provide communication between the local communication medium 36 such as but not limited to POTS, ISDN, wireless such as satellite or cellular, or cable television networks. A POTS modem may be implemented using a commercially available modem chipset such as those produced by Rockwell which are prevalent in the market. For cable Internet access, a cable modem by Motorola and an Ethernet interface chipset can be used as the network interface module. These network interface modules may be designed to be modular such as using the PCMCIA standard so that the appliance can be easily modified for interfacing to the desired choice of network access.

A read only memory (ROM) chip 62 and 62', such as programmable erasable read only memory (EPROM) chip or Flash ROM chip, contains high-level control computer program code to manage all the other devices and deal with network protocols and standards. Flash ROMs provide the added benefit for automatic field upgradability for quick and easy software updates and patches which can be easily performed by the user. Such control code is described in more detail below by the flowcharts describing the appliance operation. The memory chip 62 and 62' may also be programmed to contain a unique network address, a phone number of a local network access provider, memory cache to store information such as recipients' network addresses and telephone numbers, long-distance calling codes that are currently serviced by network service providers for communication with such an appliance, and networking information such as gateway and authentication information. These user setups will be discussed in detail.

Audio compression and decompression may be provided by the central processor 58 and 58' or by dedicated audio/video compressors/decompressors 56 and 56' such as the TrueSpeech CT8020 Digital Signal Processor (DSP) chip available from DSP Group, Inc. of California or by general purpose DSP chips such as Analog Devices' AD21xx family of DSP chips or Texas Instruments' TMS320 family of DSP chips that can be programmed with audio or video compressors and decompressors (codecs) licensed or sold by numerous vendors, such as Lucent Technologies, Intel, and DSP Group. Audio codecs can comply to the following International Telecommunications Union (ITU) standard such as G.711, G.722, G.728, G.723, G.723.1, and G.729. G.723 and G.723.1 standards are preferred for low bit-rate voice communications on low bandwidth network access medium such as POTS. Video compression and decompression may

The information stored in both the primary and redundant databases are synchronized at regular intervals using standard coherency techniques to maintain the same information. The user information stored in the database includes a unique identifier such as the user's telephone number. The slot for this value in the database is generally permanent for all users of appliances or a compatible appliance or system that is allowed to use this communication system. The value may be modified for example, if a user changes location. The database also includes for each user an identifier which indicates an address for the user when the user's appliance is connected to the packet-switched network. This identifier may be dynamic or fixed, depending on how the addresses are assigned by the network. These network identifiers are used to establish call connection between two or more users. The database may also include other useful or pertinent information for each user such as a subscriber's name, residential address, e-mail address, network service provider's IP address, and billing information.

As the user base increases, the CDBs may be distributed geographically to maximize the efficiency of CDB access and for redundancy. Multiple CDBs can be synchronized to make sure that the databases contain the same information for redundancy. It is also possible to have distinct databases with respective redundant databases for separate groups of users in different locations especially as subscriptions increase. Queries can be processed, for example, by multicasting or broadcasting them to each database.

The following is a scenario of using distinct databases for specific regions. Each database, wherever located world-wide, contains the network addresses of every CDB and the information of every appliance user in that local region. If a new CDB is installed, all existing CDBs are updated with the new CDB's IP address. If a caller in one location calls a recipient at a remote location and the recipient's information is unavailable when the caller's appliance contacts the local CDB, the CDB associates the long-distance dialing codes (e.g. country and area code) with the remote CDB's network address to allow the caller's appliance to establish a link with the remote CDB at the recipient's location. The remote CDB may then take over to continue the process of linking the communication channel between the caller and recipient. In instances where some other recipient's information is used which does not provide sufficient locale information such as the recipient's Internet username or domain name, the CDB can multicast or broadcast the recipient's information to all other CDBs in order to identify the locale of the recipient. Once the remote CDB has been identified, it can then take over to continue the process of establishing the communication channel between the caller and the recipient.

example, in the U.S., if the call is determined to be a long distance call from the standard telephone number prefix such as a "1" for inter-state or intra-state long-distance call or "011 + country code" for international long-distance call, the caller's appliance then checks its internal phonebook to see if the recipient's number is present (step 103) as described in detail with Fig. 8. If the recipient's number is found in the phonebook, the calling process continues to step 104. The appliance establishes in step 104 a connection with the recipient's appliance by a conventional circuit-switched network call. If the call is not answered, as determined in step 105, and if no retry is to be performed (step 106), the user may hang up (step 108) by placing the phone handset on-hook. If the call is answered, the caller informs the recipient that a call with this appliance is being made. For example, the caller may request that the recipient press a key on the telephone handset, such as the "*" key or pressing a button the appliance. If the recipient cannot be connected via the appliance for any reason (step 112), a conventional toll call may be continued (step 114) and eventually terminated (step 116); the phonebook check of step 103 helps to minimize this occurrence but it is conceivable that the recipient's appliance could be malfunctioning or has been disconnected. If the recipient has a properly functioning appliance, both appliances hang up (in step 118) and both parties' appliances automatically connect with their network service providers, as described in more detail below in connection with Fig. 8. They may obtain an IP address (steps 120 and 122) dynamically or may already have a static IP address assigned by their network service provider.

With an IP address, each party's appliance then contacts a centralized database to exchange the network addresses to each party (steps 124 and 126) referencing each party's unique identifier such as their respective telephone numbers, as described in more detail below in connection with Fig. 10. In particular, the central database is updated with the recipient's IP address in step 124 and the central database is updated with the caller's IP address in step 126. The caller then queries the central database to receive the recipient's IP address in step 128, as described in more detail below in connection with Fig. 12. If the address is not found, as determined in step 130, the caller's appliance continuously tries to identify the recipient's IP address as indicated by 130 in the loop back to step 128. If one minute or other time limit, has passed, the attempts to access an IP address are terminated and the caller is informed in step 134. The telephone call then may be terminated. If the IP address is found, the caller may establish contact and make a TCP connection with the recipient as indicated at step 136. Also, if the recipient is using the telephone line for general Internet access and the recipient's computer

call mode if the number dialed checks with the internal phonebook. If an Internet call is not desired, the appliance will just continue with PSTN toll call (step 436). If an Internet call is desired, the caller's appliance will dial the number and will make sure to allow for a maximum of only two or three rings (usually two) to let the recipient's appliance identify the caller's telephone number (step 440). If the recipient has not yet picked up the phone and the appliance detects that the caller is an appliance user by checking its internal phonebook in step 442, the recipient's appliance will wait until the ringing stops in step 446. If the recipient picks up the phone before the appliance has had a chance to identify the caller, the operation reverts back to the first mode. If the caller is identified not to be an appliance user as determined by the internal phone book, then the recipient's appliance will let the call process as a conventional one (step 444) and let the phone ring. After waiting for two or three rings, the caller's appliance will then automatically hang up in step 448 and continue with the rest of the first mode of operation beginning with step 122'. If the recipient has not yet picked up the phone and the caller has been identified as an appliance user by the recipient's appliance, the recipient's appliance will then continue to establish an Internet connection with steps 120' and 124'. While the appliance attempts to establish an Internet call connection and the recipient picks up the phone, the appliance will so inform the recipient that an Internet call is in progress with the caller identified on, for example, an LCD display. The recipient will have control to cancel an Internet call in progress if so desired by pressing a button on the appliance or a button on the handset such as the "*" or "#."

Benefits to the second mode of operation is that it uses the existing services available from most POTS network service providers without modifying their software or hardware just like the first mode of operation. Another same benefit to this mode is that the caller may call from any compatible communication system rather than an appliance if the caller somehow knows that the recipient has this appliance or the caller' appliance is provided with the protocol to contact the central database and conduct outgoing PSTN toll calls to the recipient. However, one major disadvantage of the caller being charged for the initial PSTN toll call associated with the first mode of operation is reduced or eliminated. The second mode of operation also eliminates the need for the recipient to intervene by picking up the handset and pressing a button to initiate an Internet call as in the first mode of operation. The second mode of operation increases the ease of establishing an Internet call and also helps to reduce PSTN long-distance charges even further.

a communication channel. In another method, the recipient's appliance or DCF sends an information packet containing the recipient's network address to the caller's appliance upon which the caller's appliance initiates the communications channel using the recipient's network address. Whichever way, a communication link between the caller and the recipient may be established to begin transmitting information packets over the network.

One embodiment of the data flow associated with the third mode of operation will now be described in more detail in connection with the flow chart of Fig. 6a. In particular, the caller dials the recipient's telephone number into the appliance using a conventional telephone connected to the appliance or directly into the appliance integrated with a conventional telephone in step 200. The appliance then determines whether the telephone call is long distance, as determined in step 202. If the telephone call is not a long distance call, the appliance makes a local telephone call over a plain old telephone system (POTS), in step 204. If the call is determined to be a long distance call, the caller's appliance checks its internal phonebook to see if the recipient's number is present (step 205) as described in detail with Fig. 8. If the recipient's number is found in the phonebook, the calling process continues to step 206. The caller's appliance automatically dials a local network service provider (NSP) or DCF to establish a PPP/SLIP link (step 206), as described in more detail below in connection with Fig. 9. If a PPP/SLIP link is not established as determined in step 208, a retry may be performed in steps 210 and 206 or the appliance or caller may hang up in step 212. If a PPP/SLIP link is established, the caller's appliance sends a packet with the recipient's access information to the local central database (step 214) and queries the central database for the IP address of the recipient's dedicated communication facility step 216. This step is described in more detail below in connection with Fig. 12. If the IP address of the recipient's dedicated communication facility is not found, as determined in step 218, the caller may be given an option to make a conventional toll call in step 220. If no toll call is to be made, the appliance or caller hangs up in step 222. Otherwise, a toll call may be made through a conventional public switched telephone network in step 224. When the call is completed, the caller hangs up in step 226.

If the caller connects to the network and identifies the IP address of the recipient's dedicated communication facility, the appliance then sends a packet with a caller's IP address and the recipient's access information, e.g., its telephone number, to the recipient's dedicated communication facility in step 228. This information allows the recipient's DCF to connect with the recipient's appliance over the recipient's network access medium, for example, by making a

DOSP is not found, as determined in step 518, the caller may be given an option to make a conventional toll call in step 520. If no toll call is to be made, the appliance or caller hangs up in step 524. Otherwise, a toll call may be made through a conventional public switched telephone network in step 522. When the call is completed, the caller hangs up in step 514.

If the caller connects to the network and identifies the IP address of the recipient's DOSP, the caller's appliance then sends a packet with the recipient's access information, e.g., its telephone number, to the recipient's DOSP in step 526. This information allows the recipient's DOSP to connect with the recipient's appliance over the recipient's network access medium, for example, by making a telephone call, to establish a point-to-point protocol link in step 528. During this process, the caller may be informed of the call status with phone ringing sounds on the recipient's telephone. This process is described in more detail below in connection with Fig. 11. If a link is established, the DOSP requests the recipient to indicate acceptance of the network phone call by, for example, pressing the "*" button on the handset in step 530. Steps 530 through 566 is essentially the same as that of the first and second modes of operation shown in Fig. 5a from steps 110 through 144.

A benefit of the fourth mode of operation is that initial long distance toll calls over the public switched telephone network for establishing an network connection between the caller and the recipient are completely eliminated. Another benefit of the fourth mode is that it does not involve modification to network service providers but rather uses less expensive (compared to network service providers) dedicated dial-out service providers to allow the outgoing telephone calls to be made to the recipient. However, the delay in making a connection may be twice as long in comparison to the first mode.

The fifth mode of operation will now be described with reference to Fig. 7. If continuous network access such as cable Internet access is used by the caller, a continuous network link is provided so that there will not be a need to dial into the service provider nor conduct authentication. If the recipient has such continuous Internet access, the caller automatically dials the recipient via packet-switched means without the need for conducting a short long-distance call as associated with the first mode of operation; the caller could have accessed the Internet via any means. This is similar to the third mode of operation described above using POTS Internet access however, using a continuous Internet access such as cable does not require any modifications to the cable service provider. This operation mode is also much faster for connection than the first, second, or third mode of operation.

long-distance call and incurring toll charges to determine if a recipient is capable of receiving a network call via the Internet and also provides the caller an option to cancel the call without establishing a toll connection with the recipient. If the recipient's phone number is found in its internal phonebook, the processes in Fig. 5 or Fig. 6 continue. However, if the recipient's phone number is not found, the caller is informed of this status (step 404) and requests the caller to decide if the appliance or compatible system should check if the recipient is a subscriber (step 406). If the caller decides not to conduct the check, the caller is given the option to continue with a PSTN toll call (step 408). If the caller decides not to continue with a toll call, the appliance hangs-up (step 414). Otherwise, a conventional long-distance call is made (step 410) and upon call completion, the appliance hangs-up. If the caller decides to check if a recipient is a subscriber, the caller's appliance dials into the local network service provider to establish a PPP/SLIP link (step 416). Upon establishing the PPP/SLIP link, the caller's appliance queries a central database server with the recipient's telephone number to check the status of the recipient's subscriber status (step 418). If the recipient is determined to be not a subscriber, i.e., not in the database at the decision step 420, then the procedure for a request to continue with a PSTN toll call (steps 408-414) is carried out. Otherwise, the central database sends a confirmation packet to the caller's appliance with the telephone number and any other pertinent information (step 422). The caller's appliance automatically updates the phonebook with the recipient's information (step 424) and the caller is informed of the update (step 426). Upon completion the subsequent steps are then continued. The appliance's user interface will allow any telephone number in the phonebook to be added, deleted, or edited.

How the appliance dials into a network service provider or dedicated communication facility to establish PPP/SLIP link will now be described in more detail in connection with Fig. 9. This example assumes that the network service providers are accessed using a regular telephone line (i.e. POTS). It is possible to make such a connection via a cable television modem or by connection through electrical power lines, among other mechanisms. In this embodiment, the appliance makes a regular telephone call to a network service provider to make a connection as indicated at step 250. If a connection is not made, as determined in step 252, the appliance may retry this operation as indicated at 254 and 250. Otherwise, the caller may be informed that connection was not made in step 256 and the appliance hangs up in step 258. If a connection to the network service provider is made, authentication information is sent to the provider in step 260. If authentication is not achieved, as determined in step 262, a retry of the

packaged in a packet which is then sent to the caller's appliance in step 298.

The CDB request may be substituted by broadcasting and multicasting for any mode of operation. In such an embodiment, the caller's appliance processes the information packet and broadcast/multicast it to the world-wide Internet or other "white-page" services such as the "People Find" service from Lycos, or the "Big Yellow" Internet business yellow pages to obtain the recipient's individual information. The CDB or the recipient's DCF answers with at least the DCF network address when a matching recipient is found. After establishing contact with the CDB or recipient's DCF, the caller's appliance has the option to store and maintain the recipient's information in a local cache, i.e., phonebook for future use to minimize continual connections with CDB in an effort to reduce delays in establishing contact with the recipient for subsequent phone calls. If the recipient's or recipient's DCF network address is unavailable, the caller's appliance is informed and may be provided with an option to make a conventional long-distance phone call or automatically switch to the first mode of operation if the recipient was determined to be a subscriber as described above.

Example packet types which may be used by the system are shown in Figs. 13 and 14. These packets are transmission control protocol (TCP) packets that communicate over dedicated ports. The TCP packet shown in Fig. 13 includes a first byte of data indicating a type which may include a central database query, phone query, dedicated communication facility update, phone update, additions and deletions, or message indicating the party is ready to talk. The next four bytes of data indicate a length which represents the length of the data field 304 which follows. The data portion of the packet may contain one or more type, length and value entities, such as shown in Fig. 14. The type field 306 indicates a type such as whether the data includes a phone number. The length field 308 indicates the length of the value field 310. By using such packets, each of the central database, dedicated communication facility and the appliance readily may identify information which it needs to process, and how that information should be processed.

How a recipient's dedicated communication facility dials a recipient's appliance to establish a PPP/SLIP link, such as performed in step 230 of Fig. 6, will now be described in more detail in connection with Fig. 11. This operation is performed in manner similar to how a computer generally contacts a network server provider via a modem. In particular, the dedicated communication facility dials out to the recipient via the plain old telephone system (POTS) or other access media used by the appliance, in step 320. After step 320, if the caller hangs up

appliance.

By using the mechanisms described above, a caller's appliance ensures that a connection is made between the packet-switched network and the recipient of a telephone call. At least three modes of operation may be used in order to ensure that this connection is made. Additionally, with these appliances the network service providers of the caller and recipient do not require dedicated ports for voice communication. Accordingly, the cost of long distance calls may be reduced without substantially increasing the cost of maintenance of specialized voice communication hardware on the part of the network access providers. By providing a dedicated appliance such telephony is not limited to computer users and owners. With these features this telephony appliance may be used in the same manner as a conventional telephone.

Having now described a few embodiments of the invention, it should be apparent to those skilled in the art that the foregoing is merely illustrative and not limiting, having been presented by way of example and practice. Numerous modifications and other embodiments are within the scope of one of ordinary skill in the art.

For example, other communication protocols over a packet-switched network may be used such as TCP/IP, Frame Relay, ISDN, and IPX providing for reliable transmission or User Datagram Protocol (UDP) that uses Real-Time Protocol (RTP) to handle streaming audio and video and which is a part of the ITU H.323 standard for unreliable transmission. Wireless and asynchronous transfer mode (ATM) networks operating using packet or cell switching also may be used.

Additional functionality also may be provided, such as video and wireless capabilities. An example of video and wireless capability might include a mobile appliance that functions in a vehicle such as an automobile where the outgoing packet-switched communications signals such as video signals are sent by processing video images of the sender using a charge-coupled display (CCD) area sensors such as those sold by Sony Corporation and audio signals are sent by processing voice or audio from the sender using a microphone with active acoustical error cancellation circuitry for full-duplex hands-free speakerphone operation. The incoming packet-switched communication signals are also processed and delivered to the recipient via same wireless means. The incoming processed audio may be transmitted, for example, through the automobile's speakers via radio frequency (RF) signals sent directly to a radio's antenna inside the vehicle. The incoming processed video may be transmitted via a high-resolution liquid crystal display (LCD) such as those sold by Fujitsu or a miniature cathode ray tube (CRT) such

CLAIMS

1. A communication system for communication using a packet switched network, comprising:

a first network access system for providing access to the packet switched network;

a second network access system for providing access to the packet switched network;

a first appliance having means for connecting to the first network access system through a first access medium, and means for sending and receiving packets through the means for connecting to the packet switched network;

a second user appliance having means for connecting to the second network access system through a second access medium, wherein the second appliance includes means for causing the first appliance to connect to the packet switched network through the first network access system using the means for connecting to the first network access system, and means for sending and receiving packets to and from the first appliance through the means for connecting and the packet switched network.

2. The communication system of claim 1, wherein the means for causing the first appliance to connect to the packet switched network in the second appliance comprises:

means for connecting with the first appliance using a public switched telephone network; and

means for instructing the first appliance to connect to the first network access system using the means for connecting of the first appliance.

3. The communication system of claim 1, wherein the means for causing the first appliance to connect to the packet switched network in the second appliance comprises:

means for identifying the first network access system; and

means for instructing the first network access system to connect with the first appliance through the means for connecting in the first appliance.

4. The communication system of claim 1, further comprising:

a central database of user information including, for each of the first and second appliances, a first unique identifier indicating an address for the appliance accessible using the packet switched network and a second unique identifier indicating an access mechanism for establishing a connection over an access medium between the first and second network access systems and the first and second appliances, and comprising means, operative in response to a query, for returning one of the first and

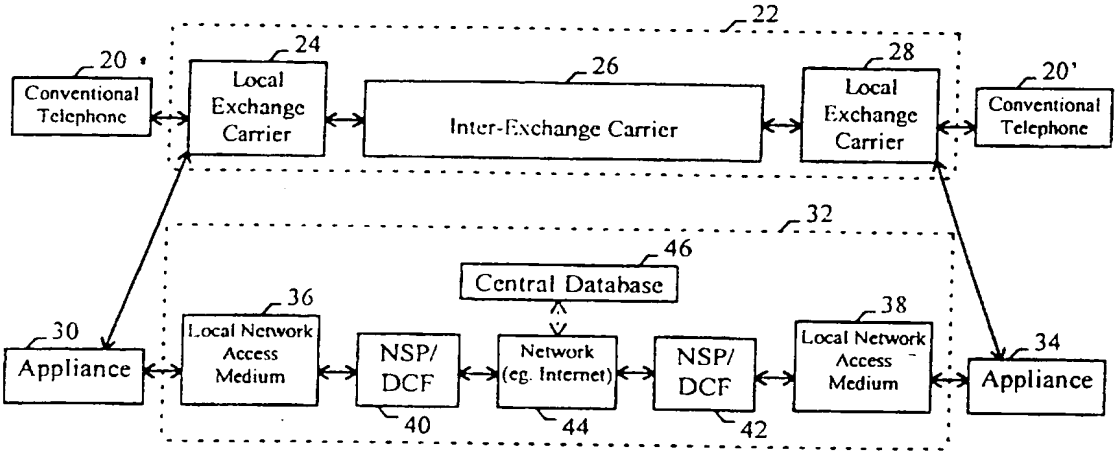

FIG. 1

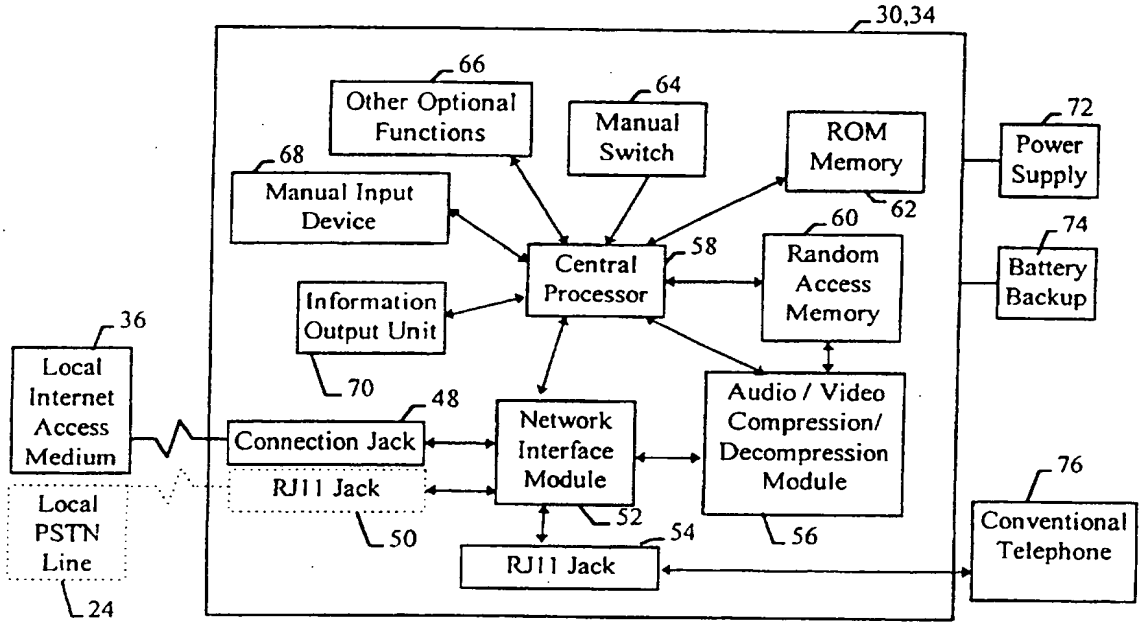

FIG. 2a

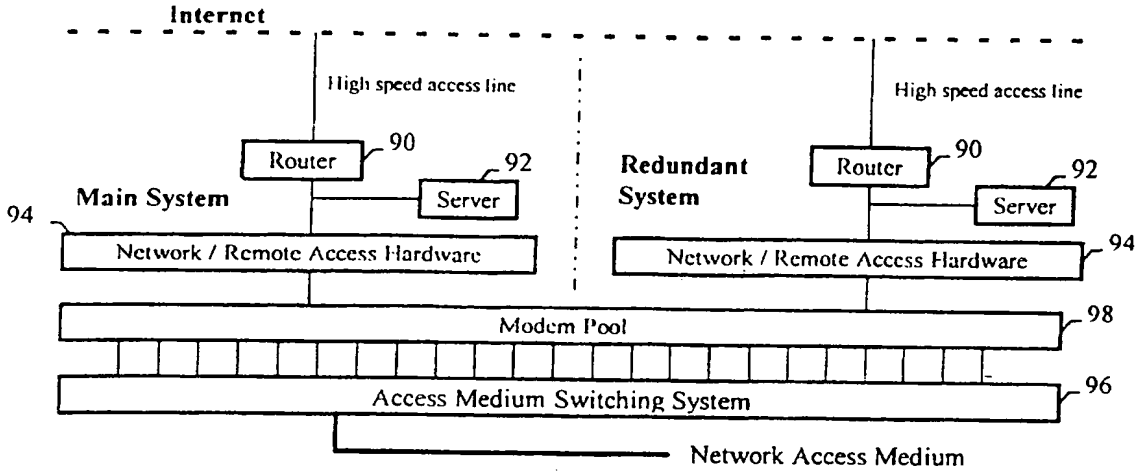

FIG. 4

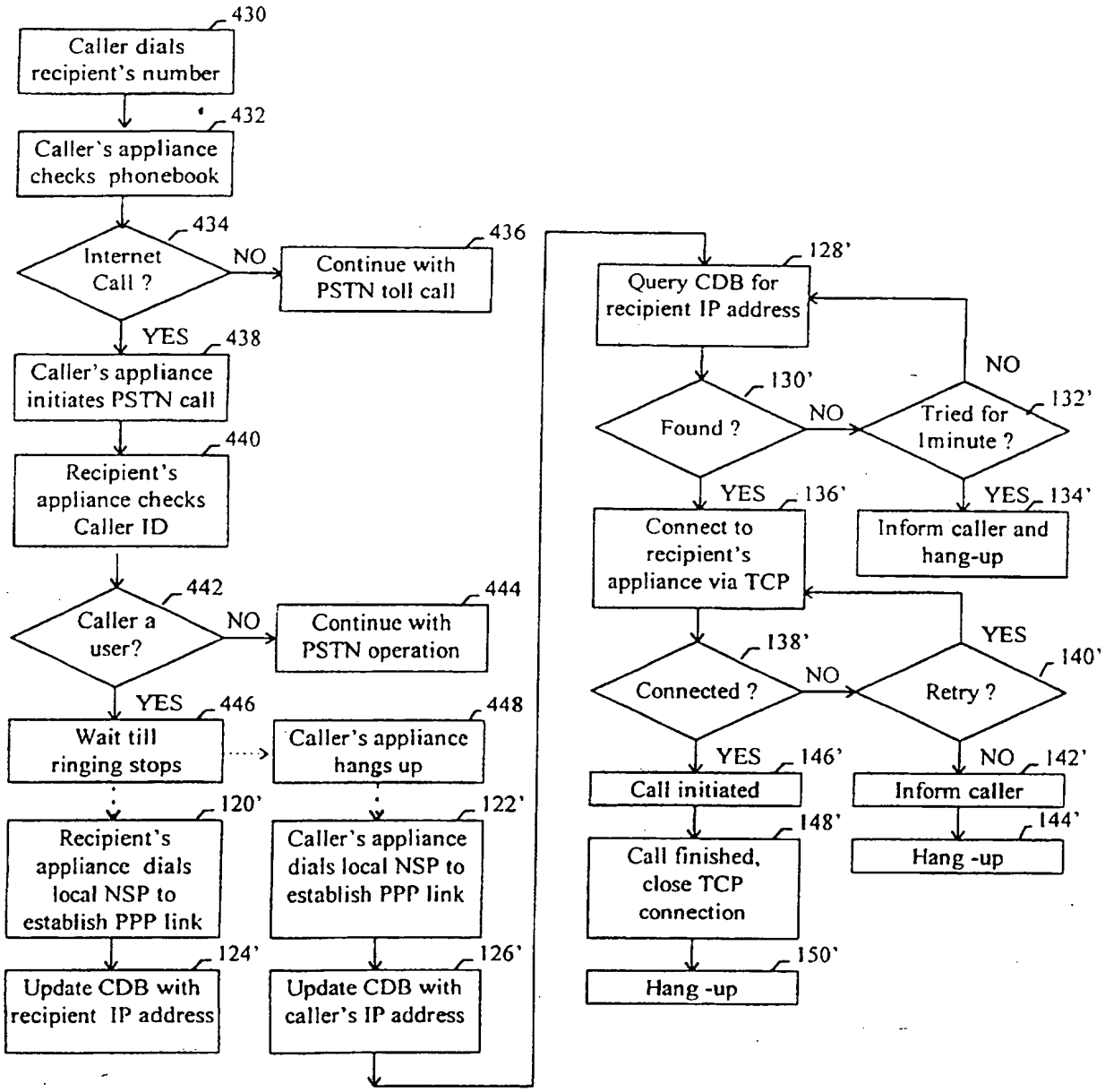
430
Caller dials recipient's number
432
Caller's appliance checks phonebook
434
Internet Call ?
NO
436
Continue with PSTN toll call
YES
438
Caller's appliance initiates PSTN call
440
Recipient's appliance checks Caller ID
442
Caller a user?
NO
444
Continue with PSTN operation
YES
446
Wait till ringing stops
448
Caller's appliance hangs up
120'
Recipient's appliance dials local NSP to establish PPP link
122'
Caller's appliance dials local NSP to establish PPP link
124'
Update CDB with recipient IP address
126'
Update CDB with caller's IP address
128'
Query CDB for recipient IP address
130'
Found ?
NO
132'
Tried for 1minute ?
NO
YES
134'
Inform caller and hang-up
YES
136'
Connect to recipient's appliance via TCP
138'
Connected ?
NO
YES
140'
Retry ?
YES
146'
Call initiated
NO
142'
Inform caller
148'
Call finished, close TCP connection
144'
Hang -up
150'
Hang -up

FIG. 5b

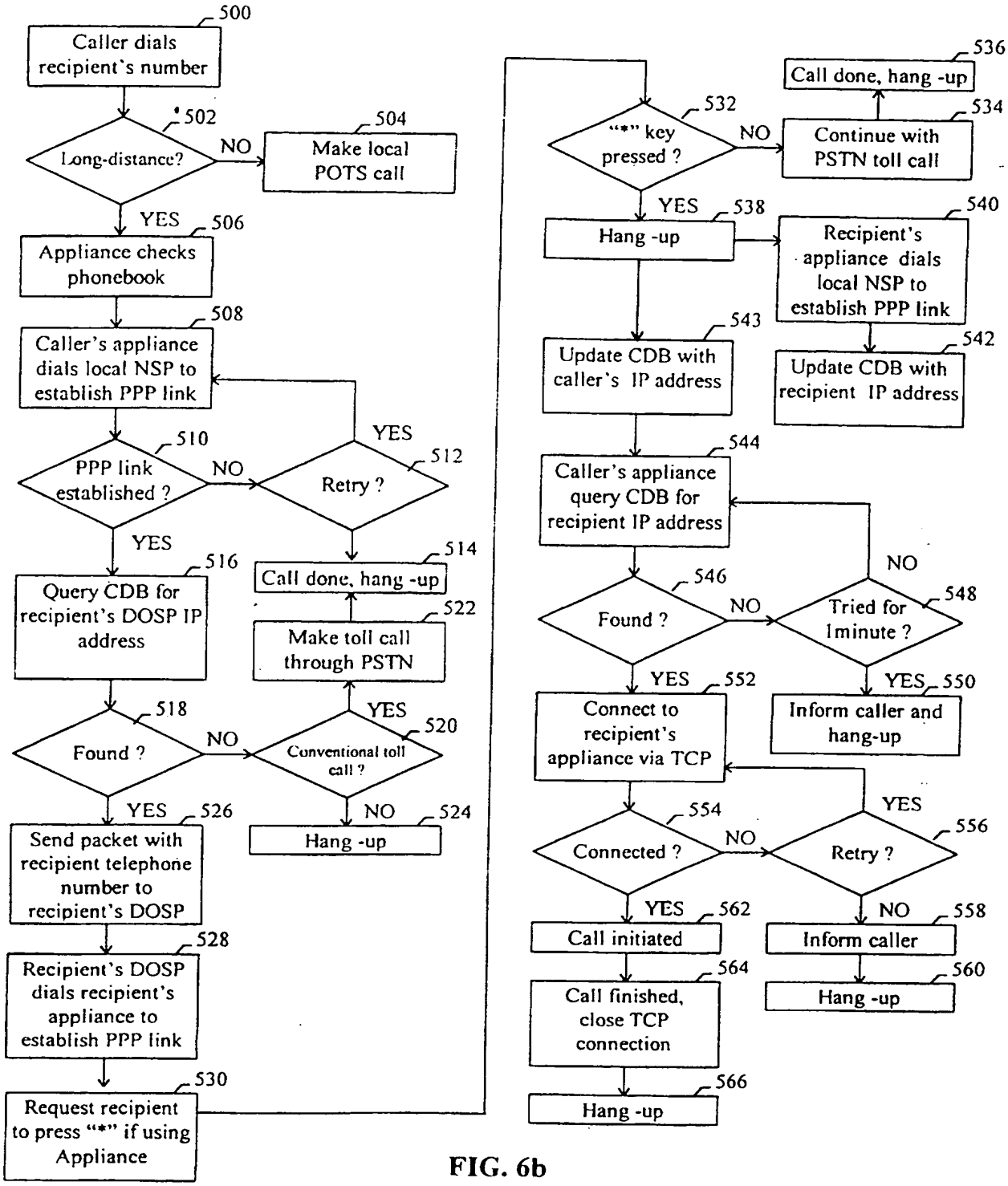

FIG. 6b

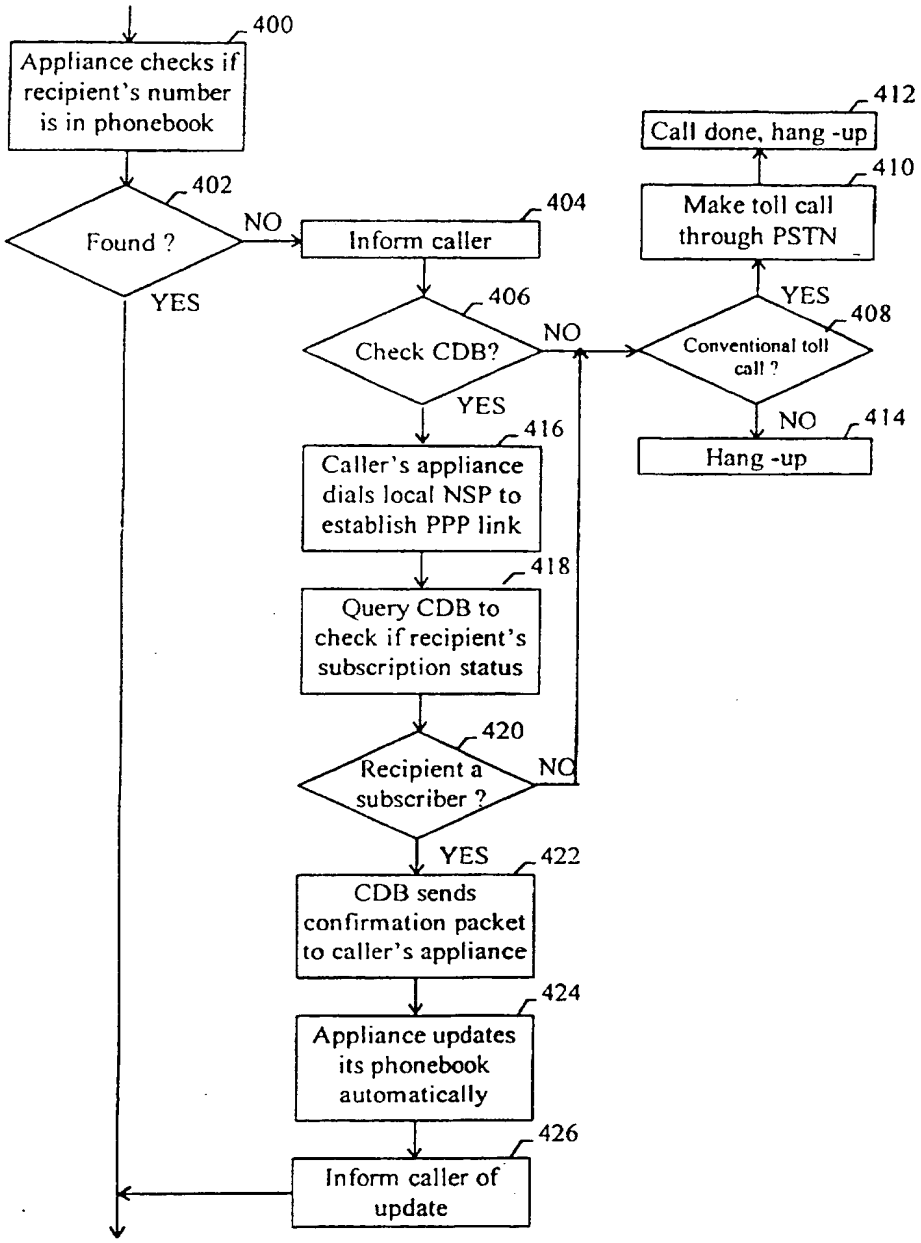

FIG. 8

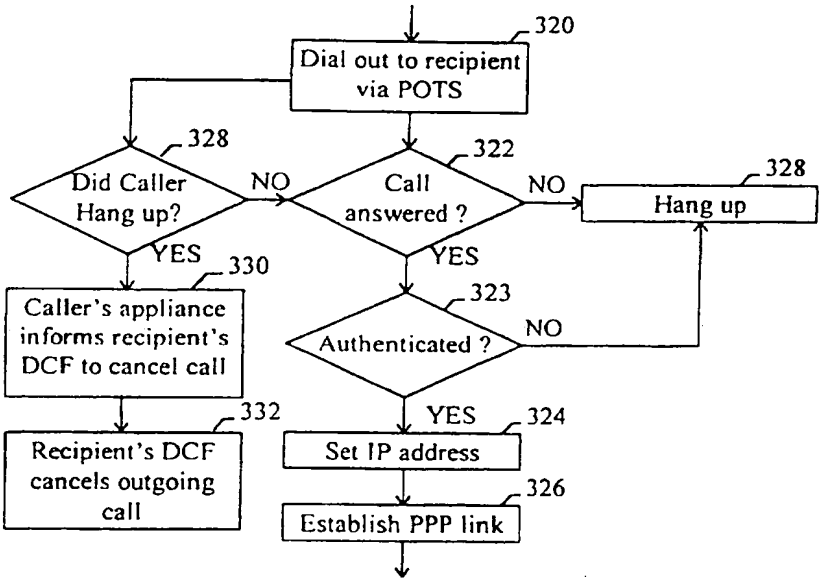

FIG. 11

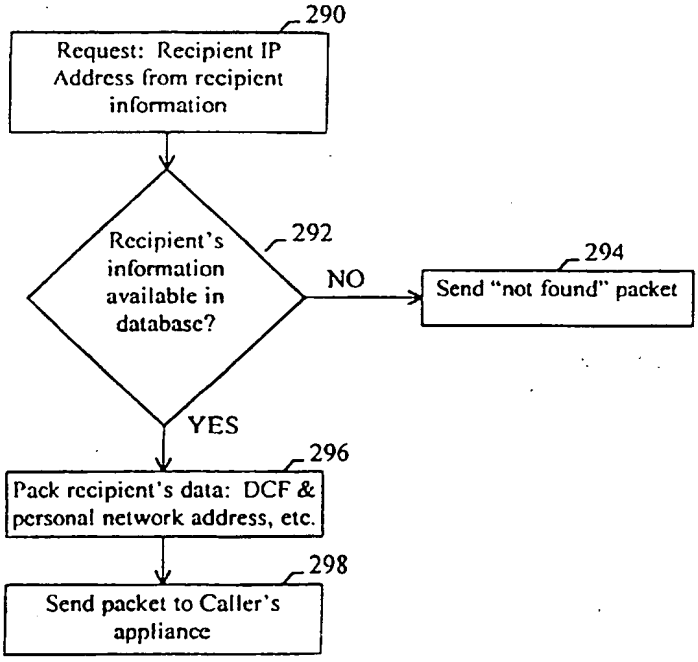

FIG. 12